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TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No. AM-8304

In Re Application Of: Wolfgang ADERHOLD

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
10/788,979	27 February 2004	S. Y. Paik	60300	3742	6862

Invention: BACKSIDE RAPID THERMAL PROCESSING OF PATTERNED WAFERS

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Wolfgang ADERHOLD	**Attorneys Docket:**	AM-8304
Serial No.:	10/788,979	**Confirmation No.:**	6862
Filed:	February 27, 2004	**Art Unit No.:**	3742
Examiner:	S. Y. Paik		

For: "BACKSIDE RAPID THERMAL PROCESSING OF PATTERNED WAFERS"

Commissioner for Patents
Alexandria, VA 22313-1450

APPEAL BRIEF UNDER 37 CFR §41.37

Sir:

This Appeal Brief is filed in support of the appeal of the above application dated September 13, 2007.

(i) REAL PARTY IN INTEREST

The real party in interest in this appeal is the assignee, Applied Materials, Inc. of Santa Clara, California.

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(ii) RELATED APPEALS AND INTERFERENCES

There are no other known appeals or interferences related to this application.

(iii) STATUS OF CLAIMS

Claims 10 – 11, 16 – 18 and 20-29 have been canceled. Claims 1 – 5, 7 – 9, 12 – 15, 19, and 30 – 32 are pending and are all appealed.

(iv) STATUS OF AMENDMENTS

All amendments have been entered.

(v) SUMMARY OF CLAIMED SUBJECT MATTER

The invention includes a method of rapid thermally processing (RTP) a wafer 12 as described for a conventional RTP chamber as described at page 1, line 25 to page 4, line 3. The type of thermal processing is wide and can include annealing, crystallization, oxidation, chemical vapor deposition, and cleaning, as described at page 1, lines 13 – 15. The cited description is directed to a conventional RTP chamber in FIG. 1 in which an edge ring 14 overlaps an undefined portion of the outer portion of the wafer 12 on its unfeatured backside to supports the wafer 12 with its features 16 being developed in the RTP processing on its upwardly facing front side exposed to an array of radiant bulbs 26. Conventionally, pyrometers 40 have light pipes 42 facing the wafer backside to measure the temperatures at different radial portions of the wafer 12 to control the amount and distribution of radiant energy delivered to the wafer.

According to the invention, as described at page 7, lines 16 – 21, the wafer 12 is inverted with its unfeatured back side facing the radiant lamps and a modified edge ring 64 supports the front side of the wafer 12 having the features 16 being developed. The pyrometers 40 then directly monitor the temperature of the features 16 being developed. The edge ring 64 is modified so that it extends inwardly from the edge of the wafer 12 only a short distance and overlaps no more than the edge exclusion zone 52 of the wafer 12. The edge exclusion zone 52 is that outer peripheral area of the wafer not having features 16, that is, integrated circuits, formed in it. It is conventionally small, extending inwardly from the wafer edge by a distance of the order of 3 mm.

As described at page 12, lines 2-17 with reference to FIG. 7, the inverted orientation of the wafer 12 allows a holding member 90 to support the wafer from above on its back side. The holding member 90 may be either a pneumatic cup or an electrostatic chuck.

The inverted orientation of the wafer provides several processing advantages over the normal upwardly facing orientation as described at page 8, line 1 to page 9, line 10.

(vi) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL.

Claims 1-9, 12-15, 17-19, and 30-32 stand rejected under 35 U.S.C. §103(a) as being obvious over:

Ballance et al. (U.S. Patent 6,090,210) or
Anderson et al. (U.S. Patent 6,113,703)
in view of Moslehi (U.S. Patent 4,891,499, hereafter Moslehi '499) or
Moslehi (U.S. Patent 4,956,538, hereafter Moslehi '538)

(vii) ARGUMENT

Claims 1 and 2

Claims 1 and 2 require the inversion of the substrate with its front side facing downwardly and its back side irradiated from an overhead radiant heat source. Claim 1 requires pyrometric monitoring of the substrate front side while claim 2 requires the thermally monitoring to be performed at plural radial positions. It is noted that claim 2 does not have proper antecedent basis in claim 1 and should instead recite a pyrometrically monitoring step.

The examiner cites several references for rapid thermal processing (RTP) including features directed alternatively to normal and inverted processing of wafers with a reason for choosing the features to be combined.

Ballance illustrates in FIG. 1 a conventional RTP chamber 10 having an upwardly oriented wafer 15 with its features in its frontside (col. 1, line 21 and col. 4, line 15) exposed to an overhead radiant lamp head 40 including tungsten-halogen lamps 44. A support ring 18 includes an inwardly extending lip 24 which holds the wafer 16 on its backside (col. 4, lines 11-15). The only guidance to the extent of the lip 24 is that its leaves most of the wafer's backside exposed to a reflector plate 28 to form a reflector cavity (black body cavity) at the back of the wafer (col. 4, lines 25, 26). Ballance includes pyrometers 34 attached to light pipes 30 directed at the backside of the wafer 16 to monitor the backside wafer temperature and accordingly control the desired wafer temperature (col. 4, lines 25-39).

The claimed RTP chamber differs from that of Ballance by the inversion of the wafer and

the details of the support ring useful for the inverted wafer.

The relevance of Anderson to the claimed invention is not clear except for claims 31 and 32. In his invention illustrated in FIG. 2 and described at col. 4, lines 17-23, his wafer 12 is enclosed in a cavity formed between lower and upper heat plates 60, 62. Radiant lamps 18, 20 irradiate the heat plate 60, 62, which are opaque radiation (col. 4, lines 36-38). That is, the lamps 18, 20 do not irradiate the wafer 12 but instead heat the heat plates 60, 62, which form a black-body cavity or oven around the wafer 12. Pyrometers 22, 24 measure the temperature of the plates 60, 60 (col. 4, lines 47, 48), not the temperature of the wafer 12. The claimed radiant heat source corresponds to Anderson's radiant lamps 18, 20. Base claims 1, 3, 8, and 12 require that the substrate back side faces the radiant heat source. In contrast, Anderson's wafer back side faces the lower heat plate 60, itself heated by the lower radiant heat source 18 20.

Base claim 1 and 3 require either thermal or pyrometric monitoring of the front side of the substrate. In contrast, Anderson pyrometrically monitors both the outer surfaces of the lower and upper heat plates 60, 62 enclosing his wafer. "Pyrometers 24 and 22 measure the temperature of plates 60 and 62, respectively and generate signals in response to the measured temperatuers." (col. 4, lines 47-49). The examiner's statement that Anderson's pyrometers measure the temperature of the wafer is incorrect. The temperatures of the outer surface of the heat plates 60, 62 measured by Anderson's pyrometers do not necessarily correspond to the temperature of the wafer enclosed by the heat plates, particularly during the rapid heat up and cool down phase characteristic of RTP. Furthermore, the plural backside thermal or pyrometric monitoring positions of dependent claims 2, 9, and 19 are not disclosed by Anderson and make no sense when the heat plates and associated black-body cavity are intended to distribute the radiant energy. Anderson is much less relevant to the claimed invention than Ballance and accordingly will not be further discussed in this first phase of briefing except with regards to claims 31 and 32..

Moslehi '499 describes at col. 5, lines 54-64 an RTP chamber 10 illustrated in FIG. 2 in which the wafer 26 is supported by three pins 50 (col. 6, lines 57-61) with its back side facing

overhead radiant lamps 24. Moslehi '499 further describes at col. 5, line 65 to col. 6, line 42, two laser beams striking the back side of the wafer 26 and the laser beams transmitted and reflected by the wafer 26 are detected by respective IR detectors 40, 42, 43, 45 to effect temperature measurement of the wafer. Such a process is not pyrometry which does not include a probe beam.

Moslehi '538 describes at col. 6, lines 33-66 an RTP chamber 10 illustrated in FIG. 2 in which the wafer 30 is placed with its back side facing upwardly towards radiant lamps 22. Two pyrometers 26, 28 tuned to different temperatures are directed by a single light pipe as a common beam across the wafer 30.

Only Ballance and Moslehi '499 describe pyrometric monitoring of the wafer. However, both Ballance and Moslehi '499 direct their pyrometers to the unfeatured back side of the wafer while claim 1 requires pyrometric monitoring of the substrate front side.

The examiner may allege that Moslehi '499 and to a lesser extent Moslehi '538 teach the inverted orientation, which could possibly be applied to the Ballance's chamber. However, the examiner is not free to pick and choose different parts of multiple references without some reason for making the combination. If Ballance teaches backside pyrometry on a frontside-up wafer and Moslehi '499 teaches backside pyrometry on a frontside-down wafer, then the ordinary mechanic must conclude that backside pyrometry is the only preference in the art so that the support system and overhead pyrometers of Moslehi '499 should be used for processing a frontside-down wafer. It is only in unpermitted hindsight that the wafer of Ballance is inverted following Moslehi '499 but the chamber structure of Moslehi '499 is ignored.

Claims 3-7

Claims 3-7 require that the frontside-down substrate is supported by an annular ring extending no further inwards than an edge exclusion zone of the substrate. Claim 4 defines one size of an edge exclusion zone.

Moslehi '538 is very vague about the support of the frontside-down wafer stating only the

wafer is placed proximate the window32 (col. 6, lines 34-36). Moslehi '499 provides the only clear description of the support of a frontside-down wafer. Specifically, as described at col. 6, lines 57-61 and illustrated in FIG. 2, the wafer 26 is supported by three pins 50 extending from a ring. This structure does not conform to the required annular shelf of these claims.

Ballance does describe at col. 4, lines 11-17 with reference to FIG. 1 an annular support ring 18 having an inwardly extending lip 24 of somewhat large extent at least as illustrated in Fig. 1. However, Ballance is supporting the backside of the wafer and his support cannot be obviously applied to a frontside-down wafer when Moslehi '499 teaches a significantly different structure for supporting a frontside-down wafer. The ordinary mechanic in viewing both Ballance and Moslehi '499 would be clearly led to adapt the proven design of Moslehi '499 for a frontside-down wafer and use the Ballance design only for a backside-down wafer.

Further, claim 3 requires that the annular shelf underlie the substrate no further inward than the edge exclusion zone of the substrate. This term does not even appear in the cited references. No art has been cited for supporting a wafer front side only within the edge exclusion zone. Ballance's support ring 18 is illustrated to have a larger lip 24 than the 3mm edge exclusion zone of claim 4 and no teaching appears in the cited art for reducing the size of such a lip. Such a design may be advantageous but the prior art does not teach it. Obviousness cannot be found in hindsight determination of advantages of a claimed invention based on concepts not even appearing in the cited art.

Claim 8

Claim 8 requires that the downwardly oriented wafer front side face a reflector. That is, a blackbody cavity is formed adjacent the wafer front side. Moslehi '499 and '538 may have a suitable geometry for this exposure of the wafer front side but they fail to disclose that their chambers have a reflector providing such a blackbody cavity. Ballance's chamber forms a blackbody cavity but it is formed adjacent the wafer backside. The applied art fails to disclose exposing the wafer front side to a blackbody cavity or that there is any benefit to doing so.

The ordinary mechanic in viewing the combination of applied references needs to more consider the function performed by the elements in achieving the desired wafer processing rather than the available structure that may be used for a previously undisclosed process. The applied art teaches placing a blackbody cavity on the wafer back side, not its front side. Accordingly, claim 8 and its dependent claims should be held allowable.

Claim 12

Claim 12 requires both that the downwardly facing wafer front side face a reflector, as in claim 8, but also that the wafer front side be supported by an annular ring. As argued above for claim 3, no art shows supporting the wafer back side on an annular ring even absent the requirement of the edge exclusion zone.

Accordingly, claim 12 should be allowed for the reasons presented above for both claims 3 and 12.

Claims 13 and 14

Claims 13 and 14 depending from claim 12 require the holding means to extend no further inward than the edge exclusion zone. As argued above for claim 3, this limitation does not appear in the applied art.

Claim 15

Claim 15 depending from claim 12 requires a detachable holding means for holding the wafer from its top. Moslehi '499 and '538 are silent as to the means they use for putting their frontside-down wafer in its processing position. The present application shows that means other than an overhead holding means may be used, such as the paddle 80 of FIG. 6. No art has been cited for the claimed feature and the claim must accordingly be held allowable.

Claims 19 and 30

Claims 19 and 30 dependent upon claims 12 and 3 respectively require the use of pyrometry on the wafer front side. As argued above for claim 1, this feature provides an additional grounds for patentability.

Claims 31 and 32

Claims 31 and 32 dependent upon claims 3 and 12 respectively require that the shelf or ring supporting the wafer front side includes a sloping shelf. The examiner cites Anderson for this feature. Anderson briefly describes his wafer support at col. 3, lines 56-65 with reference to FIG. 2. He states that the "wafer holder arms 55 terminate in discrete wafer seats 58." Discrete seats means multiple seats separate from it other, not an annular ring or shelf. The circumferential extent of Anderson's seats 58 are insuffiicent to interfere ws gas flow (col. 5, lines 40-43) Further, as can be best interpreted from FIG. 2, each seat 58 includes a inwardly sloping portion which acts as a means for centering the wafer 12 and also includes a sharp point in contact with the bottom back side of the wafer 12. Such a structure does not satisfy the recitation of claim 3 of an annular shelf extending under the substrate of the recitation of claim 12 of an annular. In any case, Anderson is teaching the support of the wafer backside, not the support of the wafer frontside. His illustrated support with sharp points extending far inside of the wafer edge is clearly inapplicable to supporting the front side of a wafer, as required by claims 31 and 32.

(9) CONCLUSION

Accordingly, base claims 1, 3, 8, and 12 and all claims dependent therefrom should be held allowable. Dependent claims 13-15, 19, and 30-32 should be held additionally allowable. The Board is respectfully requested to instruct the Examiner to allow these claims.

Date: 4 Jan 2008

Respectfully submitted,

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(viii) CLAIMS APPENDIX

1. A method of thermally processing a substrate in a reactor comprising a radiant heat source, comprising the steps of:

disposing a substrate to be thermally processed on a front side thereof facing downwardly to form features therein with a back side opposite said front side facing said radiant heat source; and

pyrometrically monitoring said front side of said substrate.

2. The method of claim 1, wherein said thermally monitoring step includes measuring temperatures at a plurality of radial positions relative to a center of said substrate.

3. A method of thermally processing a substrate in a reactor comprising a radiant heat source, comprising the steps of:

disposing a substrate to be thermally processed on a front side thereof to form features therein with a back side opposite said front side facing said radiant heat source, wherein said disposing includes supporting said substrate with a peripheral fixture including an annular shelf extending under the substrate around its center but no further inward than an edge exclusion zone of said substrate; and

thermally monitoring said front side of said substrate.

4. The method of claim 3, wherein said edge exclusion zone has a width of no more than 3mm.

5. The method of claim 3, wherein said substrate is disposed with said front side facing

downwardly.

7. The method of claim 1, further comprising reflecting heat emitted from said front side of said substrate back to said front side across a radiation cavity.

8. A method of thermally processing a substrate in a reactor comprising a radiant heat source in opposition to a reflector extending parallel to a surface of said substrate and facing said surface over substantially all of said substrate, comprising the step of disposing a substrate to be thermally processed on a front side to form features therein with said front side facing downwardly and towards said reflector and a back side of said substrate opposite said front side facing said radiant heat source, whereby said reflector reflects radiant energy produced in said substrate by said radiant heat source and emitted from said front side back to said front side.

9. The method of claim 8, further comprising thermally monitoring a plurality of positions on said front side.

12. A thermal processing apparatus, comprising:

a radiant heat source for directing radiant energy downwardly;

means including an annular ring for holding a wafer with a back side thereof facing said radiant heat source, a front side of said wafer opposite said back side being processible in said thermal processing apparatus to form features on said front side; and

a reflector disposed on a downward side of said wafer to reflect back to said front side radiation produced by said radiant heat source and emitted from said front side, wherein said radiant heat source is disposed above said reflector.

13. The apparatus of claim 12, wherein said holding means overlaps said front side only within an edge exclusion zone of said wafer.

14. The apparatus of claim 13, wherein said edge exclusion zone extends no further than 3mm from an edge of said wafer.

15. The apparatus of claim 12, further comprising a detachable holding member capable of holding said wafer from a top side thereof.

19. The apparatus of claim 12, further comprising a plurality of pyrometers having view ports directed at said front side through apertures in said reflector.

30. The method of claim 3, wherein the step of thermally monitoring includes pyrometry.

31. The method of claim 3, wherein the shelf is a sloping shelf.

32. The apparatus of claim 12, wherein the ring includes a sloping annular shelf.

(ix) EVIDENCE APPENDIX

NONE

There is no evidence other than the cited and applied prior art references submitted to date in this appeal.

(X) RELATED PROCEEDINGS APPENDIX

NONE

There are no known related proceedings and hence there are no decisions available for such proceedings.